Chapter 24
Sustainable Development and Blue Growth in the Alboran Sea: Enabling Ocean Health and Ecosystem Services Through Ocean Science and Equitable Governance

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24.1 Introduction

The Mediterranean Sea is an important route for merchants and travelers since ancient times, allowing for trade and cultural exchange; for instance, it is estimated that the Mediterranean accounts for 15% of the yearly global shipping activity (REMPEC 2008), which makes the Mediterranean a remarkable region for its contribution to global economy and trade. In this context, most of that maritime traffic crosses the Alboran Sea: in 2010, the Spanish Authority on Maritime Rescue reported 112.943 vessels. Considered a large marine ecosystem, its coasts support a high density of inhabitants, and it is one of the top tourist destinations in the world.

With an overall lack of exclusive economic zones (EEZs) and consequently with fish stocks that are often shared among fleets from different countries, the fishery sector and associated commerce have always played an important role in the region. In fact, the annual production of roughly 1.22 million tons offers employment

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J. C. Báez et al. (eds.), *Alboran Sea - Ecosystems and Marine Resources*,
https://doi.org/10.1007/978-3-030-65516-7_24

opportunities to several hundred thousand people, supplies seafood products for human consumption to local and regional markets, and creates many other indirect benefits, maintaining the social foundation of coastal communities. In addition, fisheries are also an intrinsic part of the cultural landscape, as highlighted by old Roman mosaics and paintings, and the livelihoods of the Mediterranean and Black Sea countries (FAO 2018).

In this framework, the Alboran Sea is a peculiar region connecting the Atlantic Ocean and the Mediterranean Sea, and it represents a natural boundary between Europe and Africa. The Alboran Sea shelters a great variety of natural and human resources and activities including fishing, wildlife, research, transport, and tourism that historically have been exploited by different countries, mainly Spain (from North) and Morocco and Algeria (from South). The Alboran Sea represents a regional Mediterranean space where North and South worlds merge, creating a geopolitical region where marine resources and maritime activities should be managed from both national and international perspectives and also offering and creating opportunities for scientific cooperation.

This chapter presents a step-by-step discussion on the scientific and political changes experienced in the paradigm of the marine ecosystem management in the Alboran Sea (but also valid for other regions). The chapter starts with an analysis of the scientific logic explaining the evolution from a single-species management to an ecosystem-based management. It follows with a discussion on the need of a new socioecological narrative, which have ultimately crystallized in a series of regional policies (leaded by both the United Nations and the European Union) aimed to consolidate the sustainable and responsible use of our resources and ecosystems as an international and common obligation with ourselves and with the future generations. The chapter concludes with a set of recommendations and leverage points aimed to strengthen the scientific cooperation, to enable an equitable management, and to promote fair and effective governance for good environmental stewardship of the Alboran Sea.

24.1.1 Parts and Wholes: The Evolution of Ecosystem Management Paradigm

Within the ecological systems theory, one of the most challenging problems is the management of natural resources. The thinking evolution from a management approach based on single species to an ecosystem-based management (EBM) approach denoted a big theoretical improvement. Even with all the practical difficulties of operationalizing and implementing it, the EBM is nowadays the dominant model in the management of natural resources and marine ecosystems worldwide. And so it is in the Alboran Sea.

The EBM was framed by Christensen et al. (1996), but even earlier, Lubchenco (1994) defined some of the context, language, and goals of EBM, and in 1994, she wrote the following: “In fact, this approach represents a paradigm shift from the

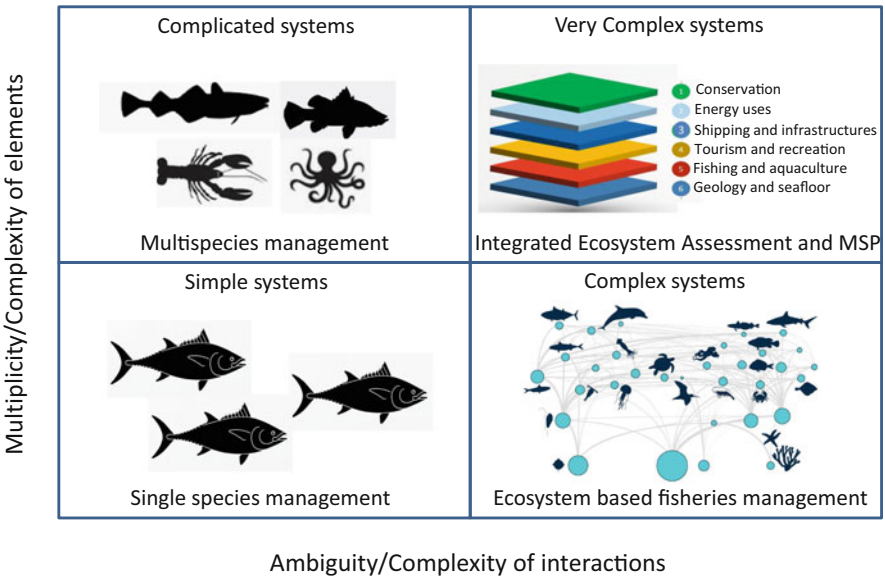

Fig. 24.1 Diagram showing different species and ecosystem management models according to the structural differences between systems complexity of elements and complexity of interactions (the flow diagram model reproduced with permission of Xavier Corrales)

highly focused short-term sector-by-sector resource assessment and management approach in general practice today by natural resource stewardship agencies, to the broader more encompassing ecosystem approach that moves spatially from smaller to larger scales, and from short-term to longer-term management practice."

This change in management practice was not exclusive of fisheries or marine ecosystems. Terrestrial ecosystem-based management (often referred to as ecosystem management) came into its own during the conflicts over endangered species protection and forest and wildlife resources in the United States in the 1990s (Slocombe 1993; Boyce and Haney 1997).

The diagram in Fig. 24.1 is based on a matrix of structural differences between systems complexity of elements and complexity of interactions as formulated by Ulrich and Probst (1988) and shows very visually the transition from the different management stages (from single-species management, to a multispecies management, to the EBM approach). We can distinguish four types of systems dependent on the number of elements and their behavior over time. Understanding these four conceptualizations as different stages along a continuum of resource management models helps to clarify the evolution of different visions of ecosystem management.

The single-species management is the simplest system, and the goal is to obtain the maximum sustainable yield (MSY), which is the largest annual catch that can be taken from a species' stock (lower left panel in Fig. 24.1). Complicated systems are characterized by a large number of elements and in this example correspond to

mixed and multiple fish stock, which are harvested together by a common fleet (upper left panel in Fig. 24.1).

But an ecosystem is much more than the mere accumulation of species. It is a network of multiple and complex interactions. That means that it is not only their structure which is complicated, but also their state is constantly changing, and due to the high dynamic, their behavior is not fully predictable. Therefore, the EBM implies the understanding and management of a complexity of interactions (lower right panel in Fig. 24.1), which in this context is defined as the ability of a system to take up a large number of different states over time (Ulrich and Probst 1988). In the diagram, these interactions are represented by the output of an Ecopath with Ecosim (EwE) model in the Eastern Mediterranean Sea (Corrales 2019) (for more information on Ecopath with Ecosim models, see Pauly et al. 2000).

Very complex systems imply the acknowledging of interdependency connections by a large number of elements, including the linkages between marine ecosystems, terrestrial systems and human societies, economies, and institutional systems. These additional elements are represented in the diagram by the marine spatial planning (MSP), which is a process that brings together multiple users of the ocean (e.g., fishing, shipping, energy, conservation, recreation) to make informed and coordinated decisions about how to use marine resources sustainably (upper right panel in Fig. 24.1).

The only appropriate approach, to deal with the cumulative pressures and effects of human uses on marine ecosystems, is for various contributing sectors to set common goals for the protection or management of ecosystems. While some policies may only affect a single sector, others may affect multiple sectors.

Once these concepts were incorporated into the management thinking, projecting this new approach into social science and socioeconomic strategies was only a matter of time, and the "sustainable management" concept to manage ecosystem resources and services was fully assimilated into policy documents, For instance, into the United Nations Sustainable Development Goals (SDG) (UN 2015), into the FAO (2014) Blue Growth Initiative (BGI), and into the European Commission Integrated Marine Policy (EC 2007) and its Blue Growth Strategy (EC 2017).

At a time when humanity is being challenged by many pressures forcing environmental changes at planetary scale, there is no other way than the sustainable management (imbibed into the EBM and MSP) to manage the marine environment in an integral way. The more information we can gather about an ecosystem and all of the interconnected factors which affect it, the more capable we will be of better managing that system. While we are gaining in complexity, we will be rewarded by having healthy oceans and well-being for all of us. At the same time, we will cope with the major achievement of acting with solidarity and equity with both the developing countries and among generations.

In summary, adopting a "sustainability imperative" requires that we do a much better job of managing the natural resources, such as fisheries, while respecting the other sector's interests and human uses of the ocean; the need for integrative studies has never been more important (Rothschild 2015).

24.1.2 The Emerging Socioecological Narrative

In 1998, Jane Lubchenco published a seminal paper entitled *Entering the Century of the Environment: A New Social Contract for Science*. Among other inspiring thoughts, she wrote: "The false assertion that society must choose between the economy and the environment is often made. In reality, this 'jobs versus the environment' choice is a false dichotomy: the real choice is between short-term gain and long-term, sustained prosperity.... A sustainable biosphere is one that is ecologically sound, economically feasible, and socially just.... We can no longer afford to have the environment be accorded marginal status on our agendas. The environment is not a marginal issue, it is the issue of the future, and the future is here now" (Lubchenco 1998).

She concluded that the interfaces between the environment, human health, the economy and social justice are ripe for developing and entraining into the policy arena. In fact, the awareness of humanity about the depletion of natural resources and the compromised sustainability of the lifestyle of western societies have highlighted the relevance of environment science, and the society is demanding more proactive policies to preserve our environment while maintaining sustainable and equitable growth.

Among the intellectual and practical challenges to be achieved at the light of the UN SDG and the 2030 Agenda, we can mention the alleviation of pollution of regional seas and oceans, the rational exploitation of marine resources, the mitigation of global warming and climate alterations, the global cycle of carbon, or the maintenance of biodiversity. Given the complexity and magnitude of these challenges, the demand for marine environmental data from the scientific community and from society is growing, and therefore, oceanography is a science that increasingly attracts the attention of the scientific community and citizens. And, of course, marine science, observation, and data are also fundamental to underpin and deliver scientific advice to the decision-makers and managers, who must do effective the sustainability of the natural and social systems.

In order to achieve a scientifically engaged society, it will be necessary to develop a culture where science is recognized as relevant to everyday life (Pielke 2007). The public must know that science theory is based in facts and associated with objective realities. Also public awareness on the consequences of environmental risks might help to increase pressure on larger organizations to address impacts at larger scales (e.g., to achieve commitments to mitigate risks at the country or international level).

On the other side, marine scientists often find themselves in the position of having relevant information available which they need to share with others outside of the scientific community. Such information should be put into use when designing local and national polices on adaptation and mitigation and when developing strategies to achieve the UN SDGs.

The Alboran Sea marine scientific community must be prepared to use the policy opportunities as a vehicle to reinforce and add value to marine scientific research and to facilitate the transfer of knowledge and technology to third parties (this is a key to

ensure cohesion in marine science and development). The active involvement of end users of scientific information, including resource managers, policy-makers, and individual citizens, will enhance the impact and value of our research initiatives and findings. For that, we need to understand, maintain, and extend our relationships to relevant UN agencies, international councils, global programs, and NGOs and participate in alliances and international agreements related, for instance, to ocean governance for a safer, more equitable, cleaner, and prosperous ocean for all.

In summary, to be influential and shape action, we must strengthen the interface between society, policy, and science. Considering that the challenges for society are formidable and will require substantial information, knowledge, wisdom, and energy from the scientific community (Lubchenco 1998), the ability to make marine science understandable to those who make decisions about our future is critical; it should be made clear that the sustainability of tomorrow depends on what we do today.

24.2 International Framework for Sustainability and Maritime Governance in the Alboran Sea

24.2.1 The Balance Between Environmental Research and Decision-Making

Democratic societies have led to a consensus and political commitment toward an environmental sustainability and practices respectful with the environment. The currently happening changes are so vast, so pervasive, and so important that they require our immediate attention (Lubchenco 1998). In consequence, environmental policies have evolved from being much targeted to being more holistic, which implies more knowledge demands, in particular to characterize the added complexities and uncertainties of integrated issues having long-term consequences.

These commitments are embodied in the numerous international conventions which set targets for improving environmental quality supported by specific monitoring programs. Among others, we can mention the Barcelona Convention, International Convention for the Prevention of Pollution from Ships (MARPOL), the IMO regulation and management of ballast water in ocean vessels, the EU Marine Strategy Framework Directive, and many others (major detail in Chap. 2 of this volume).

In addition to the conventions, there are also several international instruments and science-policy interfaces that have been agreed by the member states represented at the United Nations, such as the UN World Ocean Assessment (WOA), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and the Intergovernmental Panel on Climate Change (IPCC). These science-policy processes must ensure that updated and accurate science is appropriately reflected in high-level policy discussions (e.g., Conferences of Parties of the

Convention on Biological Diversity (CBD) and United Nations Framework Convention on Climate Change (UNFCCC)).

While setting environmental policies on a global scale as a political goal, the pressure will increase for science to respond more quickly and effectively to the needs of society and participation in the decision-making process and governance. Researchers and scientists should investigate sustainability questions that society defines as important and move beyond a purely technological approach to sustainable development in all dimensions (Schmalzbauer and Visbeck 2016). Underlying the development of policies for sustainable management is the assumption that policy decisions are based on a reasonably certain knowledge base, or the required knowledge can be obtained (Schmalzbauer and Visbeck 2016). However, the interdisciplinary research underpinning the study of sustainable management often lacks this knowledge base, and it can be only achieved if there are investments for more solution-oriented research and for scientific research to improve the knowledge and functioning of the dynamic and changing future.

From all that commented, (i) there is a scientific and social demand to increase our capabilities in oceanographic research in the Alboran Sea, (ii) there is a political consensus on the need to establish environmental sustainability practices, and (iii) there is the technological capacity to improve our data and models, but the paradox is the limitation given mainly by the economic impossibility that a single scientific institution undertakes with charge to its budgets the necessary investments.

Decision-makers must ensure that scientific analysis is articulated in conjunction with other tools such as social impact assessments, and that information is accompanied by a road map, including a timeline with targets and indicators. Because there are other factors affecting environmental decision-making (as the possible irreversible outcomes and the difficulties of balancing short-term gain against long-term uncertain loss), the consequences of the human behavior should be made as clear as possible, e.g., based on scenarios, so that the actors can envision the outcome of their actions. Although necessary, such prioritization is complicated because the priorities may vary for various actors (e.g., business operators, resource managers, NGOs, or governments).

24.2.2 Recent International Developments to Improve Ocean Governance and Sustainability

Seas and ocean international dimension is reflected in its extensive regulatory development. In the Mediterranean Sea (major detail in Chap. 2 of this volume), more than 50 international, general, and regional treaties can be applied, although not all countries are signatories or have ratified them. These treaties cover a wide spectrum of subjects: from fishing to discharges, pollution, biological diversity, or different aspects of navigation and transport. It is essential for management plans that all uses and activities are already regulated. The United Nations Convention on

the Law of the Sea (UNCLOS 1982) has special relevance, as it constitutes the legal instrument that defines and regulates the different jurisdictional concepts and the access of states to the sea. Regionally, the Mediterranean Action Plan (1975) and the Barcelona Convention (1976) and its various protocols (among them the Protocol on Biological Diversity and Specially Protected Areas (1995) and the Protocol on Integrated Management of Coastal Zones (2008)) have a special impact on this matter (spatial planning) and in particular with regard to cooperation between coastal states (cross-border dimension of planning plans).

The 2030 Agenda for Sustainable Development, adopted by all United Nations member states in 2015, comprises a collection of 17 global goals set and are envisioned as the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to ocean, climate, environmental degradation, clean energy, responsible production and consumption, and international partnerships. The goals are broad and interdependent, yet each has a separate list of targets to achieve. Several nations' governments have begun to incorporate sustainable development in their planning and policy and have found great legitimacy and ownership.

The SDG 14 defined as "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" provides for the first time ever an opportunity to step up action on individual ocean-related issues and expand the profile of the ocean in the development agenda. This standalone SDG for the ocean summarized more than 500 proposals submitted from highly diverse stakeholders, which were framing in a number of targets to preserve and restore life-sustaining functions of the ocean and the role of ocean resources in providing a basis for human and economic development. As the SDGs are intended to pursue transformational change, they include aspirational and intentionally broad elements, and therefore, targets must be viewed not only individually but also in relation to each other SDG (Valdés 2017).

The concept of blue growth came out of Rio+20, and FAO uses this term to emphasize the need for growth particularly in the fisheries and aquaculture sectors. The goals of the BGI are to maximize economic and social benefits while minimizing environmental degradation from these sectors (FAO 2014). These goals are closely aligned with the 2030 Agenda for Sustainable Development. While there are no national obligations and approaches remain flexible for different national and regional realities, the BGI is aligned with other FAO regulations such as the Code of Conduct for Responsible Fisheries to stop illegal, unreported, and unregulated (IUU) fishing (FAO 2001).

The planning of the maritime space and the management and monitoring of the environmental status of the marine environment are reaching further development in the European Union framework and within its integrated maritime policy (IMP) (published by the European Commission in 2007) where maritime spatial planning together with blue growth, marine data and knowledge, integrated maritime surveillance, and watershed strategies constitutes the five main policies that IMP encompasses and coordinates.

The Marine Strategy Framework Directive (Directive 2008/56/EC of June 17, 2008) of the European Parliament and of the Council establishes a framework for community action for marine environment policy, with the main aim of achieving or maintaining a good environmental status of the marine environment no later than 2020. Its transposition into Spanish regulations has been carried out through Law 41/2010 of December 29 on the protection of the marine environment.

The development of maritime space planning plans is regulated by Directive 2014/89/EU, whose transposition into Spanish regulations has been made by RD 363/2017 of April 8.

24.3 The UN Sustainable Development Goals as an Opportunity for Marine Science and Better Ecosystem Management in the Alboran Sea

24.3.1 The Contribution of Science in Implementing the UN SDGs

Achieving the Sustainable Development Goals approved by the UN General Assembly in 2015 (also named Agenda 2030) requires a transformational thinking by the states and the society.

There will be no single straight path toward global sustainability and prosperity. This is where science comes in and takes a holistic approach to identifying and understanding trade-offs between different targets, as well as detecting synergies that can mobilize and boost action. This will require a goal- and solution-oriented scientific approach, and scientists can play an important role by delivering broad and deep understanding of the needs and challenges facing a particular society. Inter- and transdisciplinary science cooperation will be a consequence rather than the founding principle of such an approach (Nilsson et al. 2016; Schmalzbauer and Visbeck 2016).

While SDGs provide a coordinating and synthesizing framework for public (and private) sector decision-making, science can play a pivotal role, for example, (i) in representing sustainability challenges in different contexts (data, analysis, and scenario building), creating models that explore how different targets interact, and tracking progress toward goals (Beisheim et al. 2015; Dasgupta et al. 2015); (ii) in providing the understanding for individuals and institutions to make informed policy and management decisions; (iii) in putting the basis for new technologies (Lubchenco 1998); and (iv) also in advancing methodological approaches to nexus challenges and nexus methods in order to improve policy coherence (Schmalzbauer and Visbeck 2016).

In this regard, new science, innovation, and technology will be required to generate an integrated assessment system (e.g., achieving fisheries management objectives requires fishing activities and other human activities that affect the marine

ecosystem, e.g., tourism to be regulated). Both the social and natural sciences will need to contribute to identifying critical interactions between policies aimed at achieving specific SDGs and how possible negative interactions can be mitigated through synergy solutions and possible multipurpose actions.

In addition, it is necessary to make the most of the opportunities that seas and oceans offer to support the development of a blue economy, coordinating the efforts at national level, by defining common priority areas to promote blue growth in order to focus the efforts to tackle cross-sectoral and crosscutting issues, bringing together countries and researchers from different disciplines across boundaries to provide knowledge and conduct the research with the aim of boosting the sustainable growth of the maritime economy (European Commission 2017).

That said, inter- and transdisciplinary science is not the only approach required. Capacity building and institutions and institutional capacities need to be developed to produce integrated assessments. This is necessary in order to bridge the gap between the normative aspirations of the SDGs and the practical needs of those who are implementing the SDGs. Capacity development is a critical challenge for sustainable management in the Alboran Sea.

The proper implementation of an ecosystem-based management (EBM) approach is needed at regional level to ensure the conservation status of the ecosystem and its components. Improving our understanding of how countries can design and implement long-term pathways toward sustainable development is critical. It is necessary to remove barriers in cooperation and governance for it. A clear example of these could be the establishment of marine protected areas beyond the national boundaries for protecting marine diversity in the Alboran Sea. A network of such areas may act as a stepping stone for highly mobile species and ensure connectivity over long distances. Reducing the fishing pressure helps some depleted stocks and ecosystems to recover. On the other hand, the establishment of fisheries-restricted areas may also have some side effects, such as increasing the fishing pressure in the neighboring fishing grounds and destroying ecosystems in good condition. Making the best use of such practices requires therefore sound scientific evaluation, planning, and governance at international level.

New technologies are rapidly changing the classical approach for monitoring fisheries and implementing marine spatial planning. Vessel monitoring systems (VMS), electronic reporting, satellite data, and operational real-time and forecast products of ocean physical and biogeochemical models provide a huge amount of data that can be used and combined to propose new tools for promoting the economic and environmental sustainability of fisheries and help to achieve some of the SDG 14 targets. While geographic information systems (GIS) are becoming a classical mean of developing marine spatial planning, spatially explicit modeling of habitats, marine species distributions and ecosystems, and new methods to explore massive data (e.g., machine learning and, more generally, artificial intelligence) have tremendous potential for new applications and to support the sustainable exploitation of marine resources and the conservation of healthy marine ecosystems.

24.3.2 International Cooperation in Science: A Must to Achieve the SDG 14

The universal nature of science and research and the speed of change and its expansion, favored by the development of new innovative technologies, offer the opportunity to work in cooperation with other countries in large projects or participate in large research infrastructures.

Science is a main pillar for sustainable development and also an instrument for peace (UNESCO 2015). The science dimension of diplomacy has fundamental significance at a time when science has tremendous power to shape the future of humanity and when it is no longer appropriate to design science policy in purely national terms, especially when addressing issues affecting the entire planet such as the sustainable management of the global ocean commons (Valdés and Crago 2017).

Ocean science seeks to understand complex, multi-scale socioecological systems and services, which requires observations and multidisciplinary and collaborative research. Rapid advances in science can best be achieved with an integrated, cross-sectoral, and international engaging scientific agenda that connects upstream fundamental research with solution-oriented research (Schmalzbauer and Visbeck 2016).

Science can make valuable contributions to better understand and identify relevant options for SDG implementation. This requires fragmented knowledge communities to come together in order to provide a synthesis of the current state of scientific knowledge in the context of global sustainability (Schmalzbauer and Visbeck 2016). An international stewardship may help to prioritize SDGs from a local and regional perspective in the areas where they are going to be implemented. As an example of international umbrella in the Mediterranean Sea, the Food and Agriculture Organization of the United Nations (FAO) and its General Fisheries Commission for the Mediterranean (GFCM) have joined forces with a number of partners to further strengthen the role of science in the SDG agenda.

When considering the motivations and benefits of international collaboration in ocean science, the policy and administrative dimensions are important. Ocean science institutions and marine laboratories play a vital role in support of ocean research. There are several institutions and initiatives dealing with ocean issues in the Alboran Sea, at local, national, and regional levels. These existing organizations (such as FAO Mediterranean projects, GFCM, Regional Activity Centre for Specially Protected Areas, United Nations Environment Programme/Mediterranean Action Plan, the Mediterranean Science Commission (CIESM), the IUCN Centre for Mediterranean Cooperation) involved in ocean science and management face challenges in relation to coordination to develop their agendas. Some of these institutions specialize in particular fields and are critical in addressing a variety of scientific questions in collaboration with universities and research institutions such as studies of coastal food webs, ecosystem biodiversity, and human impacts on coastal environments and ecosystems. They also play an important role in training young scientists from the less developed countries on new methodologies and on the formation of researchers and technologists with a range of skills, experience, and

knowledge and thereby allow any individual access to skills and knowledge across disciplines. In addition, higher education is becoming increasingly important for ocean science institutions in the Alboran Sea.

There is a tremendous opportunity and need for the scientific community in the Alboran Sea to engage in and develop forward-looking research that has the potential to support new interconnected development pathways, particularly in highly interlinked areas of the SDGs. Strengthen this international collaboration, and governance will result in reducing the level of fragmentation by increasing the coordination and the definition of common agendas, creating critical mass, maximizing efficiency of investments and existing capacities, and creating synergies in marine and maritime research, technology, and innovation fields (Valdés et al. 2017).

The goal is to increase the efficiency and effectiveness of the national investments in research, technology, innovation, related infrastructures, and development of human capacities. To achieve this goal, it's necessary to improve the transnational cooperation and coordination of actions not only at the Mediterranean but also at pan-European level. This goal should face the societal challenge of having healthy and productive seas and oceans and to contribute to the European and FAO Blue Growth Initiative as well as to the UN SDG.

In line with the need to strengthen the collaboration in the region of Alboran, a recent initiative, the Foro Mar de Alboran (Rueda et al. 2019), was launched as a collaborative process, recognizing the environmental problems and challenges faced by fishermen, administrations, scientists, and society in general to the rational use of the resources of the Alboran Sea. The Foro promotes avoiding fishing discards, bringing together scientists, fishermen, professors of universities, nutritionists, and restaurateurs of recognized prestige from the region to exchange knowledge and seek joint solutions based on science for the future of the Alboran Sea and its people.

24.4 The FAO Blue Growth Initiative for Fisheries and Aquaculture in the Mediterranean

Different regional and international organizations including FAO have reiterated that marine pollution; overexploitation of many fishing target species; illegal, unreported, and unregulated (IUU) fishing; and climate change have become major threats to aquatic species and ecosystems, in addition to other threats such as coastal occupation and degradation, habitats loss, eutrophication, increasing maritime traffic, and invasive alien species (Coll et al. 2010). Consequently, these and other threats (e.g., marine litter and microplastics) affecting the Mediterranean system have negative consequences to the coastal populations.

FAO launched in 2013 the Blue Growth Initiative (BGI), which encompasses capture fisheries, aquaculture, ecosystem services, trade, and social protection. Based on the principles enshrined in the 1995 FAO Code of Conduct for

Responsible Fisheries (CCRF), the BGI is a framework which focuses on "promoting the sustainable use and conservation of aquatic renewable resources in an economically, socially and environmentally responsible manner with the aim of reconciling and balancing priorities between growth and conservation and between industrial and artisanal fisheries and aquaculture, and of ensuring equitable benefits for communities" (FAO 2014).

The BGI is based on previous concepts promoted and adopted within the FAO agenda and then by the international organizations, regional fisheries organization (RFO), and the international community. The BGI became a series of instruments derivate from previous concepts, contemplated and defined as a body of agreements sustained by the law of the sea, aiming to better the sustainable use of the marine system and their resources based on an approach that includes the social, ecological, and economic components.

The BGI of FAO includes both aquaculture and fisheries as main components. In relation to the antecedents of the BGI in relation to fisheries, a revision of how the Ecosystem Approach to Fisheries Management (EAFM) and the Blue Initiative were established in the framework of the FAO General Fisheries Commission for the Mediterranean and Black Sea (GFCM) follows. The 150th session of the FAO Council approved the amended GFCM Agreement, a new framework that not only includes in its preamble a reference to blue growth but also contains a set of modern provisions that underpin the role of fisheries and aquaculture in the Mediterranean and the Black Sea, fully consistent with applicable FAO policies, according the FAO Fisheries DG (FAO 2017).

24.4.1 EBM for Mediterranean Fisheries: From Theory to Practice

As discussed in "Introduction," the management of the fishery resources was first based on single stocks management, or target resources-oriented management (TROM) (the traditional fisheries management) was extended in countries and RFO where fishing activities target mainly one or several species. During the past 50–60 years at least, the dominant fisheries management paradigm has been to maintain the target resource population base through various controls on the species landing size and the fishing activity. This system was based on data series of capture (C) of the target stock, and it associated fishing mortality (F) and the assessment of single stocks using models without environmental considerations. The models simplify the reality but were able to produce a real management of the fishing activity through the control of the effort, establishing total allowable catches (TACs) and quotas, closed season and closed areas as main management tools to improve the stocks status and the economic revenues.

Conceptually, EBM is based on previous TROM. To apply this approach, the ecosystem in which managers must apply decisions should be previously limited and

defined, including a set of ecosystem indicators. The models used are complex and data demanding. The main problem is that there are few data series to evaluate the ecosystem variations, although recently in regions as Europe environmental and ecosystems data series are available in some countries and fisheries. EBM includes integrated management of multispecies fisheries and other ocean uses, within a geographic context incorporating a set of ecosystem and conservation objectives that is presently the case for most fisheries management plans.

Initiatives such as the 2001 Reykjavik Conference on Responsible Fisheries in the Ecosystem increased the establishment of new information technology and systems which offer integrated ecosystem assessment. RFO builds on their strengths and successes and begins work on a mutually beneficial framework for cooperation. In the case of the fisheries sector, the objectives would ensure the sustainability of ecosystem features as well as the target species. It is the human activities that are being managed, not the ecosystem.

EBM is relatively a new concept also to the GFCM region. Scientists participating at the meeting of the Subcommittee on the Environment of the Scientific Advisory Committee (SAC) of the GFCM, celebrated in 2002, pointed out that the need to discuss this concept with other international organizations was recommended to create a transversal working group or to organize, jointly with RAC/SPA and Convention on Biological Diversity (CBD) secretariat, a workshop to discuss methodological aspects and scientific initiatives for its introduction in the Mediterranean. Subsequently, Commission (FAO 2002) emphasis was on enhancing the capacity to formulate management advice in conformance with an Ecosystem Approach to Fisheries. In order to implement such mandate, the SAC adopted the organization of an "ad hoc" meeting to analyze the feasibility of the ecosystem-based management approach to fisheries in Mediterranean waters, particularly to examine the existing and applicable ecosystem-based methodologies, to assess and monitor Mediterranean fisheries (mainly those which are shared by two or more countries), and to discuss possible ecosystem-based management tools.

In 2003, FAO advanced in the definition of an Ecosystem Approach to Fisheries (EAF) a step ahead to incorporate definitively the ecosystem in fisheries management. But, what is an Ecosystem Approach to Fisheries Management? FAO explained this concept as follows: "The purpose of an EAF is to plan, develop and manage fisheries in a manner that addresses the multiplicity of societal needs and desires, without jeopardizing the options for future generations to benefit from a full range of goods and services provided by marine ecosystems" (FAO 2003a). This definition and the report of the Reykjavik meeting in 2002 (FAO 2003a) aimed to draft guidelines for an EAF (FAO 2003b) including main principles and concepts.

The interest in the implementation of an EAF has been motivated by heightened awareness of the importance of interactions among fishery resources and with the ecosystems and the advances in science, which highlight knowledge and uncertainties about the functional value of the ecosystems to humans (i.e., the goods and services provided by the ecosystems).

24.4.2 GFCM Midterm Strategy (2017–2020) and BGI

Following the introduction of the GFCM midterm strategy for the Mediterranean and the Black Sea fisheries (GFCM 2016), the region has strong ties with the cultural, social, and economic aspects of fisheries that provide important sources of food and livelihood for riparian countries and sustain the traditions and the way of life of many coastal communities. The recent GFCM report "The state of Mediterranean and Black Sea Fisheries (SoMFi)" (FAO 2018) stated that "About 75 percent of the Mediterranean and Black Sea stocks assessed are currently fished at biological sustainable levels, although the percentage has slightly decreased since 2014 (88%)" and with decreasing catches and shrinking fleets at the regional scale (compared with the average over the 2000–2023 period reported in SoMFi 2016). The report highlighted main fleet segments, areas, and species of interest and stressed on the need to improve the existing information, especially for vulnerable species, in order to have a comprehensive assessment on which to base future management measures. To solve the situation, the GFCM adopted Resolution GFCM/40/2016/2 for a midterm strategy (2017–2020) toward the sustainability of Mediterranean and Black Sea fisheries.

The existing challenges in the Mediterranean and the Black Sea fisheries require the development of tailor-made actions against the backdrop of international commitments toward the sustainability of fisheries as a means to support the livelihood of coastal communities within a blue growth perspective. The midterm strategy is framed around the following five targets:

1. Reverse the declining trend of fish stocks through strengthened scientific advice in support of management.
2. Support livelihoods for coastal communities through sustainable small-scale fisheries.
3. Curb illegal, unreported, and unregulated (IUU) fishing, through a regional plan of action.
4. Minimize and mitigate unwanted interactions between fisheries and marine ecosystems and environment.
5. Enhance capacity building and cooperation.

Concerning the target four of the strategy, GFCM stated that healthy and productive marine ecosystems are an important means to support maximum sustainable yield and to facilitate BGI. It is recognized in this target four that fisheries, as well as other anthropogenic-driven phenomena, such as climate change or the introduction of nonindigenous species, can have potentially negative effects on the marine environment and marine ecosystems.

Target five includes the urgency that contracting and cooperative parties, relevant intergovernmental and nongovernmental organizations and concerned stakeholders, enhance cooperation to promote sustainable development and BG in the Mediterranean and the Black Sea.

The development of all this initiatives related to the BG will offer to the GFCM a prominent position at regional scale to improve the fisheries and aquaculture management under the new paradigm of the BG although it will take some time/years to have a better perspective on the effects and results that this regional initiative will have on fishery resources, aquaculture, the ecosystem, and the several stakeholders' interest in the Mediterranean and the Black Sea issues.

24.4.3 The BGI and the Aquaculture in the Mediterranean Sea

An important conference on "Blue Growth in the Mediterranean and the Black Sea: developing sustainable aquaculture for food security" (FAO 2017) was celebrated in 2014 in Bari (Italy). This was an initiative of the GFCM, the Italian government, and the IUCN Mediterranean, organized in light of emerging economic, social, and environmental issues and taking stock of the progress made in aquaculture research and innovation. One of the objectives of the conference was "build consensus on a regional strategy for achieving BG through aquaculture." The conference acknowledged the key role to be played by this sector in achieving food security, employment, and economic development in the region, under a BG perspective, considering that aquaculture is an activity that plays an important role for coastal communities.

The application of the FAO Code of Conduct to the aquaculture represents a key factor in achieving a sustainable aquaculture sector in the Mediterranean and the Black Sea under the framework of the GFCM. Considering the significant achievements obtained by the aquaculture committee from its inception meeting, the outcomes of the conference were over the expectations of the organizers. Different experts underlined the importance of implementing BG in relation to aquaculture in the Mediterranean and Black Sea region as it is already endorsed by the European Union Maritime Policy (Chapela 2017). Within the conclusions of the conference, it was underlined that "aquaculture constitutes therefore a strategic sector for future development, in particular from the perspective of blue growth."

24.5 EU Main Policy Instruments for Marine Environmental Management

24.5.1 Relevance and Scope of the Marine Strategy Framework Directive (MSFD)

In the framework of the thematic strategy for the marine environment of the Sixth Environmental Action Programme of the European Community, on July 15, 2008, Directive 2008/56/EC came into force establishing a framework for community

action in the field of marine environmental policy or Marine Strategy Framework Directive (called "MSFD" or "Directive" hereinafter) (Bellas 2014). The main objectives of this Directive into others are to protect and preserve the marine environment. The MSFD in Spain is under the umbrella of Law 41/2010 for the protection of the marine environment (LPME). The LPME, in addition, includes the regulation of spatial planning (Bellas 2014). This maritime spatial planning is delimited, with the aim of facilitating the implementation of marine strategies, five subdivisions denominated "demarcations."

The Atlantic region includes three demarcations: the North Atlantic (NOR, Spanish north coast), the South Atlantic (SUD, Spanish coast of the Gulf of Cádiz), and the Canary Islands (CAN, the Canary Islands). The Mediterranean region comprises two demarcations: the Levantine-Balearic (LEBA, east coast of Spain and Balearic Islands) and the Strait of Gibraltar and Alboran Sea (ESAL). The demarcations were delimited according it biogeography and oceanographic and hydrological characteristics.

Therefore, the Alboran Sea is within the ESAL demarcation of the MSFD. Within the regional coordination, in a first step, regional expert work groups were established for the generation of a report that includes the baseline and environment status from each descriptor previously detailed (MITECO 2020).

In general, ESAL shows a good environment status in function of its biodiversity, marine fisheries resources, and habitats. However, multiple sources of impact and threats have been identified among which are listed: extraction of solids (i.e., exploitation of underwater deposits and port dredges), extractions of sands for the creation and regeneration of beaches, discharges of dredged material, regeneration of beaches and creation of artificial beaches, offshore wind farms, alteration of hydrodynamic conditions and modification of sedimentation, retention of river flow in reservoirs and other regulatory infrastructures, extraction of fishing species of commercial interest through trawling, boat anchoring, human pressures for the use of recreational coastal water and seawater (diving, noise, tourism, etc.), marine litter and other wastes, desalination plants, accidental and/or uncontrolled discharges, introduction of microbial pathogens, invasive species, ballast water discharge, and aquaculture.

Next step is the performance of the monitoring program, which they will be addressed to implement seawater strategies for the development of the continuous assessment of the state of the marine environment and will be used to estimate the resistance between the environment state of the demarcation, based on the elements listed in the Annex III of the MSFD. This second cycle is currently in progress.

24.5.2 The Challenge of Maritime Spatial Planning (MSP) in the Alboran Sea

The Alboran Sea maritime management, as in the rest of the Mediterranean Sea, does not yet have approved plans, including the northern shore where the European Directive that regulates them (Directive 2014/89/EU) already has several years. However, the regulation with spatial impact of different uses and maritime activities already has a long tradition, with perhaps fishing being the most illustrative example.

Nevertheless, due to the particular characteristic of the Alboran basin, that is, the concentration of maritime traffic within the Alboran Sea and the presence of two large ports such as Algeciras and Tangier Med, in a geo-economic context where the most important development gap is between North and South, an MSP is necessary. Around 80% of the basin are waters and seabed under national jurisdiction and, consequently, theoretically subject to the control of the coastal states. Each of these three countries, Spain, Morocco, and Algeria, can develop their own maritime space planning plans over which they exercise sovereignty and jurisdictional rights, being the state with the greatest territorial responsibility.

The Directive 2014/89/EU is the European standard that legally supports the administrative practice that has set in motion the development of the so-called maritime spatial planning plans and that in Spain has been incorporated by RD 363/2017 of April 8. This norm is only one component of a broad system—which we call here the "institutional framework"—made up of a series of legal, political elements and principles that conclude or substantiate as mandatory rules, guidelines, or recommendations.

The preparation and application of maritime spatial planning plans must take into account other mandatory rules approved by the European Parliament, in particular the directives on habitats (1992), waters (2000), evaluation of plans and programs (2001), spatial information infrastructures (2007), marine strategies (2008), and renewable energies (2009). Of particular relevance is Directive 2008/56/EC (marine strategies) as it is the basis on which, especially in Spain, maritime spatial planning plans are being developed (RD 363/2017), interpreted as an extension and prolongation of said strategies (Law 41/2010 on the protection of the marine environment).

In addition, there is an initiative that aims to support the development of MSP plans. The European Union and IOC-UNESCO have launched the so-called MSP global initiative, which includes a project in the western Mediterranean with the aim of training experts in Algeria, Spain, France, Malta, Morocco, and Tunisia.

MSP global also aims to develop methodological guides on transboundary marine spatial planning. It is precisely the cross-border dimension of the plans that is one of the strategic decisions of marine planning in the EU context, so the level of regional cooperation is a key factor in areas such as the Alboran Sea. In this sense, Spain, Morocco, and Algeria have created a platform (Exploring the Potential of Maritime Spatial Planning in the Mediterranean Sea) to deal more specifically with issues related to conservation, sustainable development, and relations between users and participants in the maritime sector, an initiative that although meritorious still lacks

the strength to advance consistently and effectively in the development of this type of plan.

24.6 Policy Implications and Leverage Points

In spite of the richness of the data presented in the previous chapters of this volume, there are still many gaps in our understanding of the ecosystem functioning in the Alboran Sea in order to produce and deliver the most efficient advice based in robust scientific knowledge. In addition, as discussed in this chapter, the Alboran Sea is facing management and governance challenges that need special attention to ensure the sustainability of the many human activities and the delivery of services provided by this ecosystem and to effectively contribute to the success of the UN SDG (Agenda 2030), the FAO BGI, the EU MSFD, and MSP directives and other international policies.

In this context, more research is needed to understand the ecosystem functioning and its resilience to environmental and human disturbances. Obtaining data with a better spatial and temporal resolution is a crucial and necessary step to take the pulse of the Mediterranean Sea and the whole Alboran Sea and then keep it under permanent review to permit the taking of management options and to revert unwanted human-induced disturbances and other undesirable environmental situations. In addition, more basic and interdisciplinary science must be boosted to increase the knowledge base needed for the most efficient and coherent advice for sustainable development.

Moreover, it is necessary to reinforce the existing national and regional collaborative systems and international frameworks to share common management policies of the marine environment. In country, bilateral North-South and South-South collaboration among universities and research institutions needs to be reinforced. As proposed during the first meeting of Alboran universities organized under the framework of the 1st Alboran Sea Forum, the common work between universities and researchers should result in reinforcing the existing collaboration between professors and research groups within the universities of the Sea of Alboran; analyze the relevance of their work (teaching, research, advice) to be useful and relevant in relation to the priorities and purposes of the international organizations competent in marine environment, fisheries, and conservation; and promote the participation of the academic sector in the conservation of the environment and marine biodiversity of the Alboran Sea.

Establish new platforms for free and open data sharing with transparent metadata accessible to all stakeholders when and where necessary, which could be also used as the basis for creating ecosystem and performance/trends joint indicators. In this context, establish pan-regional universities-science-policy interfaces (e.g., the Foro Mar de Alboran) that could help to perform a better multidisciplinary knowledge to ensure that the best scientific knowledge is available and conveyed in due time to all

decision-makers in the different states as well as to the stakeholders and the society in general.

Only with a good and proper management at ecosystem scale (e.g., ecosystem-based management, marine spatial planning) the Alboran Sea can be preserved in good health for now and for the future and have an equitable and sustainable future for all. The existing experiences of international cooperation in the subregion are time fixed or focus on partial aspects of the marine system, as the FAO-CopeMed project (http://www.faocopemed.org/) aiming to improve the cooperation, capacity building, and data sharing to evaluate shares stocks, but not other important aspects of the environment. In this regard, there is a need for an international framework of cooperation for the Alboran Sea; this can be extended to scientific research, governance, and capacity building.

The immediate target related to management and governance is to ensure that 10% of this territory is effectively protected, as indicated by the Convention on Biological Diversity and the EU Strategy of Biodiversity. Thus, there is a need to build upon a network of MPAs and marine reserves and its corresponding data collection systems to ensure that ecologically important areas are protected and that these pristine portions of the Alboran Sea regions serve as reservoirs for marine biodiversity, heritage, and culture.

Regarding the aims of management actions, this should include regional strategies for (i) implementation of marine spatial planning approaches for management, (ii) development of sustainable fisheries management plans, (iii) actions to revert the effect of climate change in the region, (iv) action to reduce the risks of entrance of new alien species, and (v) action to preserve the marine biodiversity.

As in other oceans and seas worldwide, the governance of the Alboran Sea is fragmented (fishing, shipping, offshore gas, offshore renewable energy, etc.) as if we were managing separate entities. This inequality in governance and the cost of inaction jeopardize the sustainability of ecosystem services in the Alboran Sea, and therefore, creating an integrated ocean governance framework in the Alboran Sea is a must.

There is a special urgency in applying the international regulations and measures to combat illegal, unreported, and unregulated fishing as promoted by GFCM and ICCAT and also to stop the use of flags of convenience by fishing vessels. The success of international legal instruments (e.g., international conventions), which contain commitments to reduce the human impact on the ocean and marine ecosystems (e.g., ballast water, oil spills, protected species), depends heavily on the decision of governments and states bordering the Alboran Sea, including the implementation and continuous use of national systems of control and surveillance; in this regard, there is a lack of commitment of the states in the Alboran Sea to regulate and implement such corpus of environmental legislation together.

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